

the masses of 20 BHBs and obtained spin estimates for two of them. As described herein, a rich X-ray data archive, as well as ongoing observations, are providing an intimate look at the behavior of transient BHs as they vary in X-ray luminosity by 5–8 orders of magnitude. We have obtained strong circumstantial evidence for the existence of the event horizon, and observed harmonic pairs of HFQPOs and relativistically-broadened Fe lines emanating from near the ISCO. However, the RXTE detectors are unable to resolve the Fe K line, and the HFQPOs are all near the limiting sensitivity of the mission. Further major advances will require a new timing mission with order-of-magnitude increases in detector area, **telemetry** capability, and spectral resolving power. It is important to press ahead with a new timing mission soon in order to complement effectively the vigorous programs underway in gravitational wave astronomy and in observational studies of **supermassive** and **intermediate-mass BHs**.

10 Acknowledgements; Acronyms; Section Summaries

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Acronyms

BH: Black hole
 BHB: Black hole binary
 BHC: Black hole candidate
 HID: Hardness intensity diagram
 GR: General relativity
 HR: Hardness ratio
 ISCO: Innermost stable circular orbit
 PDS: Power density spectrum
 QPO: Quasi-periodic oscillation
 PL: Power-law

Summary Points

1. The topics of black-hole binaries and candidates are introduced, along with the perspective of general relativity on black hole mass and spin.
2. The presence of a black hole is deduced from dynamical measurements of its binary companion. Twenty such systems are identified.
3. Data analysis techniques are summarized for the X-ray observations that characterize black holes.
4. Accreting black holes exhibit X-ray states that are seen as distinct and very